

1.0 INTRODUCTION

1.1 PURPOSE OF THE MONITORING PROGRAM

The U.S. Army Corps of Engineers (USACE) manages F.E. Walter Reservoir located in northeastern Pennsylvania within the Delaware River Basin. Foremost, F.E. Walter Reservoir provides flood control and a dependable water supply to downstream communities on the Lehigh River. Additionally, the reservoir provides important habitat for fish, waterfowl, and other wildlife, and recreational opportunities through fishing, and boating. Due to the broad range of uses and demands F.E. Walter Reservoir serves, the USACE monitors water quality and other aspects related to reservoir health primarily to ensure public health safety. Water quality monitoring results are compared to state water quality standards and used to diagnose other problems that commonly effect reservoir health such as nutrient enrichment and toxic loadings. This report summarizes the results of water quality monitoring at F.E. Walter Reservoir from May through October 2002. This report also discusses the relevance of the water quality measures to the ecology of the reservoir and makes recommendations toward future water quality monitoring.

1.2 DESCRIPTION OF F.E. WALTER RESERVOIR

F.E. Walter Reservoir is an integral part of the Lehigh River Flood Control Program. The authorized purpose of this project is flood control. The reservoir project was authorized as a white water project as part of Public Law 100-676, Section 6, dated November 17, 1988. Located about 9 miles southeast of Wilkes-Barre, PA, the reservoir dams a drainage area of 288 square miles. The dam can impound up to 35.8 billion gallons of floodwater. The primary surface water input into the reservoir is the Lehigh River as it flows west between Luzerne and Carbon Counties. Bear Creek, a secondary surface water input, enters the reservoir from the north. Tobyhanna Creek drains an area to the southeast and joins the Lehigh River near the headwaters of the reservoir. The reservoir is approximately 3 miles long and usually about 50 feet deep behind the dam. This past year was exceptional, however, due to drought conditions in the region and reservoir depth increased substantially to about 140-ft. Average annual discharge from the dam into the Lehigh River is approximately 625 cubic feet per second (USGS 1993).

1.3 ELEMENTS OF THE STUDY

The USACE, Philadelphia District, has been monitoring the water quality of F.E. Walter Reservoir since 1975. Over this time, yearly monitoring program designs have evolved to address new areas of concern such as health aspects of public drinking water, sediment contaminants within the reservoir basin, and most recently, investigating a

hydrogen sulfide smell near the tailwater of the dam. The 2002 monitoring program is similar to those in recent years and includes the following major elements:

- Monthly water quality and bacteria monitoring from May through October to evaluate compliance with the Pennsylvania state water quality standards;
- Meteorological monitoring of air temperature, relative humidity, solar radiation, wind speed and direction every ½ hour at the F. E. Walter Reservoir discharge tower;
- Sediment priority pollutant monitoring of PCB's, pesticides, and volatile organic compounds to evaluate sediment toxicity relative to identified screening concentrations;
- Drinking water monitoring to ensure public health safety by comparing water quality from a drinking water source to standards determined by the Safe Drinking Water Act (SDWA); and
- Hydrogen sulfide and dissolved metal sampling to address downstream hydrogen sulfide smell and further monitor the lake during anoxic conditions.
- Additional water quality monitoring at five stations along the Lehigh River below the reservoir including automated half-hour temperature recorders and physical water quality monitoring from July to October.

2.0 METHODS

2.1 PHYSICAL STRATIFICATION MONITORING

Physical stratification monitoring of the water column of F.E. Walter Reservoir was conducted eleven times between May and October 2002 (Table 2-1). Physical stratification parameters included temperature, dissolved oxygen (DO), percent of DO saturation (dependent on temperature), pH, and conductivity. Monitoring was conducted at seven fixed stations located throughout the reservoir watershed (Fig. 2-1). Surface water quality was monitored at stations downstream of the reservoir (WA-1), and upstream on Tobyhanna Creek (WA-3), the Lehigh River (WA-4), and Bear Creek (WA-5). Stratification monitoring was conducted at the reservoir-body station (WA-2), Bear Creek (WA-6), and Lehigh River (WA-7) with water quality measured at the surface to the bottom at 5-ft intervals. Three stations (WA-2, WA-6, WA-7) were conducted twice a month starting in June through October. All of the water quality monitoring was conducted with a calibrated Hydrolab water quality meter.

In this report, water quality data recorded from stratification monitoring were compared to water quality standards mandated by the Pennsylvania Department of Environmental Protection (PADEP Chapter 93). The standard for DO is a minimum concentration of 5 mg/L, and that for pH is an acceptable range from 6 to 9.

All of the water quality data collected during physical stratification monitoring are summarized in Appendix Table A-1.

2.2 WATER COLUMN CHEMISTRY MONITORING

Water column chemistry monitoring was conducted seven times at F.E. Walter Reservoir between May and October (Table 2-1). Water samples were collected at the seven fixed stations throughout the reservoir drainage area (Fig. 2-1). Surface water samples were collected at stations downstream of the reservoir (WA-1) and upstream on Tobyhanna Creek (WA-3), the Lehigh River (WA-4), and Bear Creek (WA-5). Surface, middle, and bottom water samples were collected at the reservoir-body station WA-2, WA-6, and WA-7. Surface water samples were collected by opening the sample containers approximately 1 foot below the water's surface. Middle and bottom samples were collected with a Van Dorn design horizontal water bottle.

Water samples collected from surface, middle, and bottom depths were analyzed for ammonia, nitrite, nitrate, total Kjeldahl nitrogen (TKN), total phosphorus, total dissolved phosphorus, dissolved phosphate, total dissolved solids (TDS), total suspended solids

Table 2-1. F.E. Walter Reservoir water quality monitoring schedule for 2002

Date of Sample Collection	Water Quality during anoxic conditions (WA-1, WA-2, WA-6, WA-7, LH-3)	Physical Stratification Monitoring (All Stations) **	Water Column Chemistry Monitoring (All Stations)	Trophic State Determination (WA-2)	Coliform Bacteria Monitoring (All Stations)	Sediment Priority Pollutant Monitoring (WA-2)	Lehigh Water Quality Monitoring	Drinking Water Monitoring*
21 May		X	X	X	X			
4 June		WA-2, WA-6, WA-7						
19 June		X	X	X	X			Set A and B
10 July		WA-2, WA-6, WA-7					X	
23 July		X	X	X	X	X		
7 August	X	WA-2, WA-6, WA-7					X	
20 August		X	X	X	X			Set A
5 September	X	WA-2, WA-6, WA-7					X	
3 October		X	X	X	X			
9 October		WA-2, WA-6, WA-7					X	
23 October		X	X	X	X		X	

* Set A – comprised analyses of nitrate, nitrite, and coliform bacteria contaminants.

Set B – comprised analyses for primary and secondary contaminants.

**Stratification was done at all stations once a month and twice a month at stations WA-2, WA-6, and WA-7.

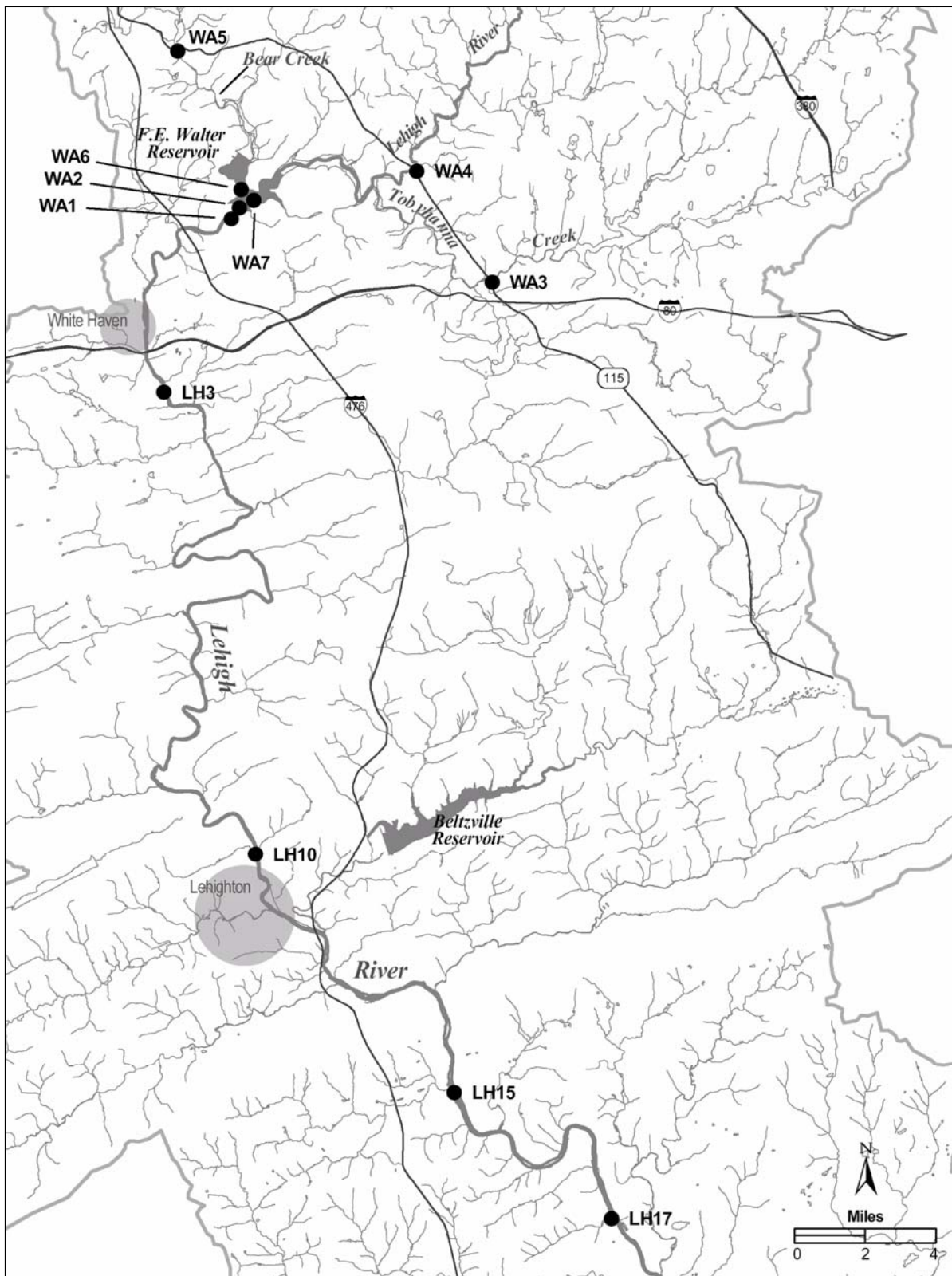


Figure 2-1. Location map for F.E. Walter Reservoir and water quality monitoring stations in 2002

(TSS), biochemical oxygen demand (BOD), alkalinity, total organic carbon (TOC), total inorganic carbon (TIC), total carbon, and chlorophyll *a*. Table 2-2 summarizes the water quality parameters; laboratory method detection limits, state water quality standards, and allowable and achieved maximum hold times for each.

Table 2-2. Water quality test methods, detection limits, state regulatory criteria, and sample holding times for water quality parameters monitored at F.E. Walter Reservoir in 2002					
Parameter	EPA Method	Detection Limit	PADEP Surface Water Quality Criteria	Allowable Hold Times (Days)	Maximum Hold Time Achieved (Days)
Alkalinity	310.1	1 mg/L	minimum 20 mg/L CaCO ₃	14	12
Biochemical Oxygen Demand (BOD)	SM5210B	2 mg/L	None	2	2
Total Phosphorus	365.2	0.01 mg/L	None	28	5
Total Dissolved Phosphorus	365.2	0.01mg/L	None	28	11
Dissolved Phosphate	365.2	0.01 mg/L	None	28	11
Total Organic Carbon	415.1	1 mg/L	None	14	2
Total Inorganic Carbon	415.1	1 mg/L	None	14	2
Total Carbon	415.1	1 mg/L	None	14	2
* Chlorophyll <i>a</i>			None		3
Total Kjeldahl Nitrogen	351.3	0.10 mg/L	None	28	14
Ammonia	350.3	0.05 mg/L	Temperature and pH dependent	28	13
Nitrate	353.2	0.1 mg/L	Maximum 10 mg/L (nitrate + nitrite)	2	2
Nitrite	354.1	0.01 mg/L		2	2
Total Dissolved Solids	160.1	10 mg/L	Maximum 500 mg/L	7	7
Total Suspended Solids	160.2	1 mg/L	None	7	7
* Chlorophyll <i>a</i> samples were calculated by averaging 10 readings per minute using a YSI 6600 with a chlorophyll sensor.					

2.3 TROPHIC STATE DETERMINATION

The trophic state of F.E. Walter Reservoir was determined by methods outlined by Carlson (1977). In general, this method calculates trophic state indices (TSIs) independently for total phosphorus and chlorophyll *a* concentrations, and secchi disk depth. Surface water measures of total phosphorus and chlorophyll *a* from chemistry monitoring were averaged in determining monthly TSI values. Secchi disk depth was measured only in surface waters at the reservoir-body station (WA-2). Trophic state determinations were made using criteria defined by Carlson (1977) and EPA (1983).

2.4 RESERVOIR BACTERIA MONITORING

Monitoring for coliform bacteria contaminants was conducted six times between May and October at F.E. Walter Reservoir. Surface water samples were collected in the same manner as for chemical parameter samples, and analyzed for total and fecal coliform bacteria contamination. Table 2-3 presents the test methods, detection limits, PADEP standards, and sample holding times for the bacteria parameters monitored at F.E. Walter Reservoir in 2002. The bacteria analytical method was based on a membrane filtration technique. All of the samples were analyzed within their maximum allowable hold times. At the end of the monitoring period, streamflow data (CFS) collected from USGS gauging stations in the region (Blakeslee and Stoddartsville) and precipitation data collected at the dam were used to correlate rainfall patterns with measured bacteria levels (see Section 2.5).

Table 2-3. Water quality test methods, detection limits, PADEP water quality standards, and sample holding times for bacteria parameters monitored at F.E. Walter Reservoir in 2002		
Parameter	Total coliform	Fecal coliform
Test method	SM 9222B	SM9222D
Detection limit	10 clns/100-mls	10 clns/100-ml
PADEP standard	-	Geometric mean less than 200 clns/100-ml (application of this standard is conservative because swimming is not permitted in the reservoir)
Maximum allowable holding time	30 hours	30 hours
Achieved holding time	< 30 hours	< 30 hours

Monthly coliform bacteria counts were compared to the PADEP water quality standard for bacteria. The standard is defined as a maximum geometric mean of 200

colonies/100-ml based on five samples collected on different days. Given our logistical limitations (all monthly sampling conducted on one day), we calculated the geometric mean based on all of the surface samples collected for each month. Although our sampling design does not fully meet PADEP guidelines, we feel that this interpretation of the coliform data meets the intent of the PADEP water quality standard for evaluating F.E. Walter Reservoir bacteria levels. Additionally, application of this standard is conservative because swimming and other human/water contact recreation is prohibited in the reservoir.

2.5 STREAMFLOW AND PRECIPITATION DATA

Streamflow and precipitation data for the principal monitoring months from May to October were compiled from USACE records (Figs. 2-2 through 2-7). Streamflow data were collected from the USGS stations located in Blakeslee and Stoddartsville and reflect rainfall patterns throughout the F.E. Walter Reservoir watershed. Precipitation data was collected by F.E. Walter Reservoir personnel and reflects a more local condition of rainfall pattern.

In May, streamflow was at its highest and peaked at approximately 2500-cfs. Monthly monitoring on 21 May was conducted at a streamflow of 930-cfs (Fig. 2-2). After the beginning of June, streamflow began to slowly decrease and continued to decrease throughout the summer. Monthly monitoring in June and July took place when streamflow ranged from 250 to 500-cfs (Figs. 2-3 and 2-4). In the later part of the summer the streamflow decreased to its lowest of approximately 60-cfs. Monthly monitoring in August was done at a streamflow between 90 to 147-cfs (Fig 2-5). Towards the middle of September there was a storm event that exceeded an inch of rain that increased the flow (Fig. 2-6). Monthly monitoring was conducted 3 October and 9 October the streamflow had decreased again to 71 and 85-cfs (Fig. 2-7). There were two storms in the middle of October that exceeded an inch of rain. These rain events increased the streamflow. Monthly monitoring 23 October was conducted at a streamflow of 210-cfs (Fig 2-7).

2.6 SEDIMENT PRIORITY POLLUTANT MONITORING

Sediment from F.E. Walter Reservoir was monitored for priority pollutant contaminants, Group 1 – PCB's, pesticides, and volatile organic compounds. Sediment was collected on 23 July at station WA-2 with a petite ponar grab-sampler. Sediment from the grab-sampler was emptied into a stainless steel mixing bowl and homogenized with a stainless steel spoon. Sediments were contained in appropriately labeled sample jars and stored on ice until shipment to the analytical laboratory. All field equipment used during the handling of reservoir sediments was decontaminated prior to sampling. Decontamination procedures were as follows: detergent wash, first deionized water rinse, 10% nitric acid rinse, second deionized water rinse, hexane rinse, and third deionized

May

2-7

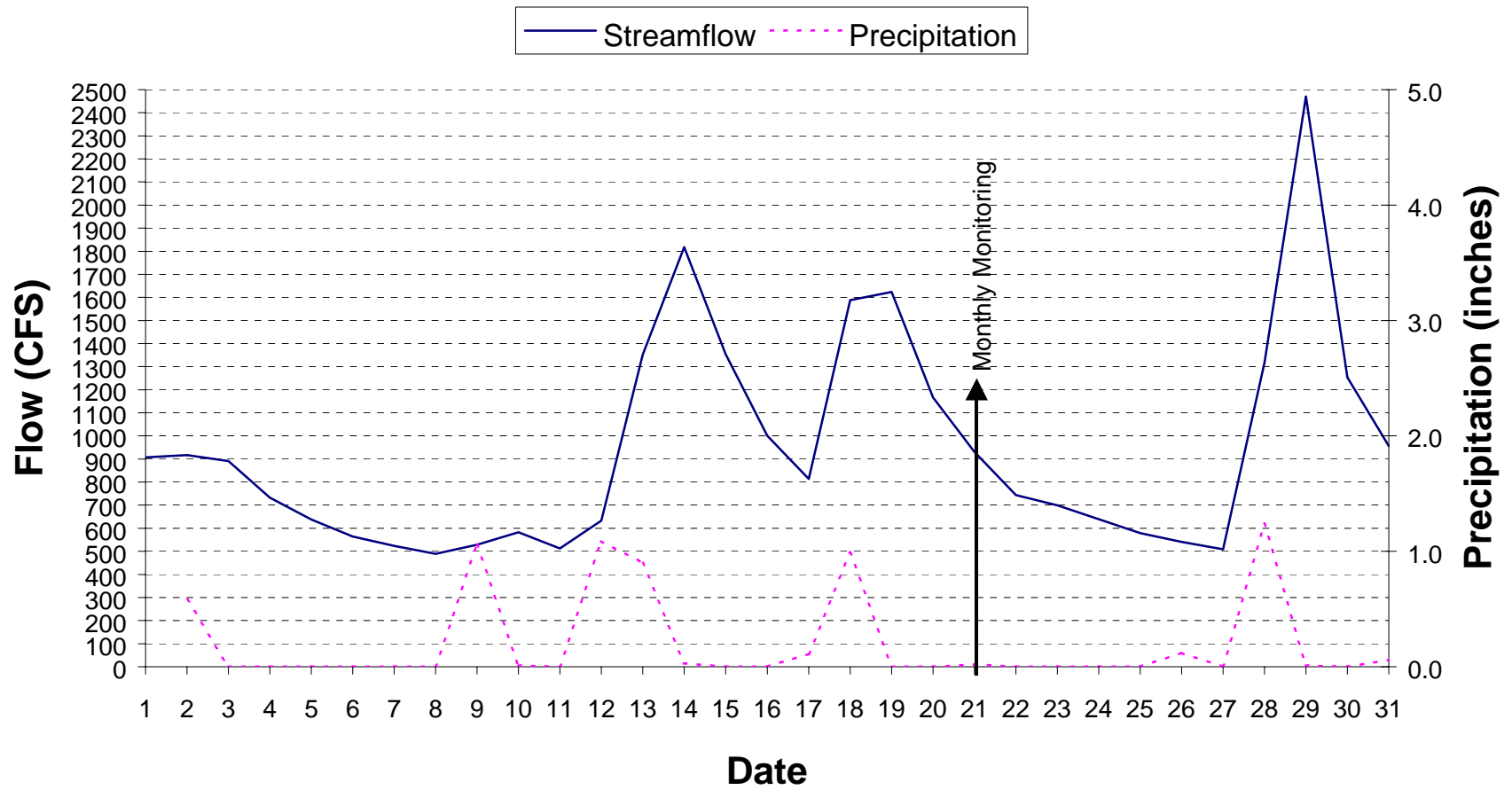


Figure 2-2. May streamflow and precipitation in the vicinity of F.E. Walter Reservoir in 2002

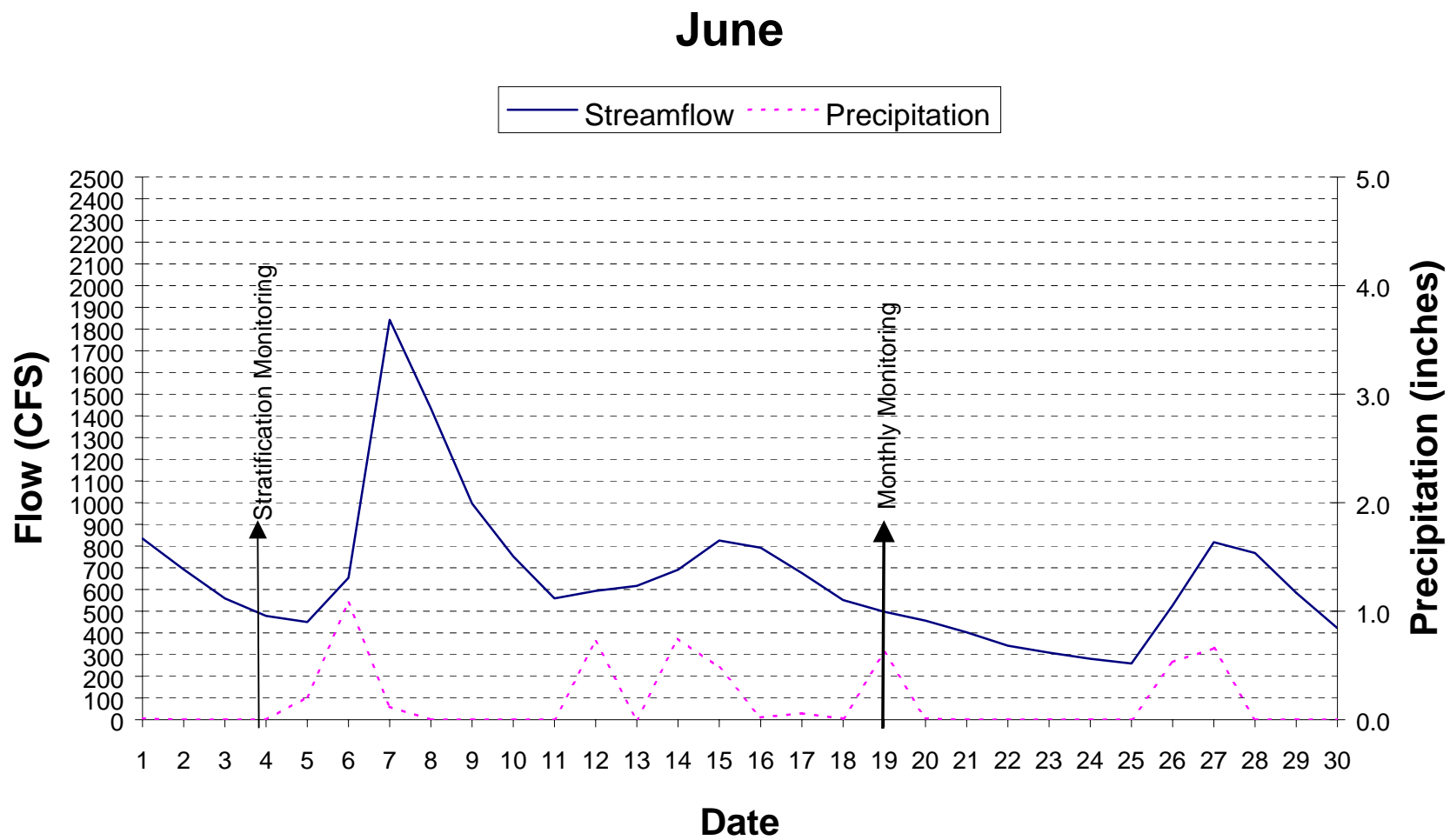


Figure 2-3. June streamflow and precipitation in the vicinity of F.E. Walter Reservoir in 2002

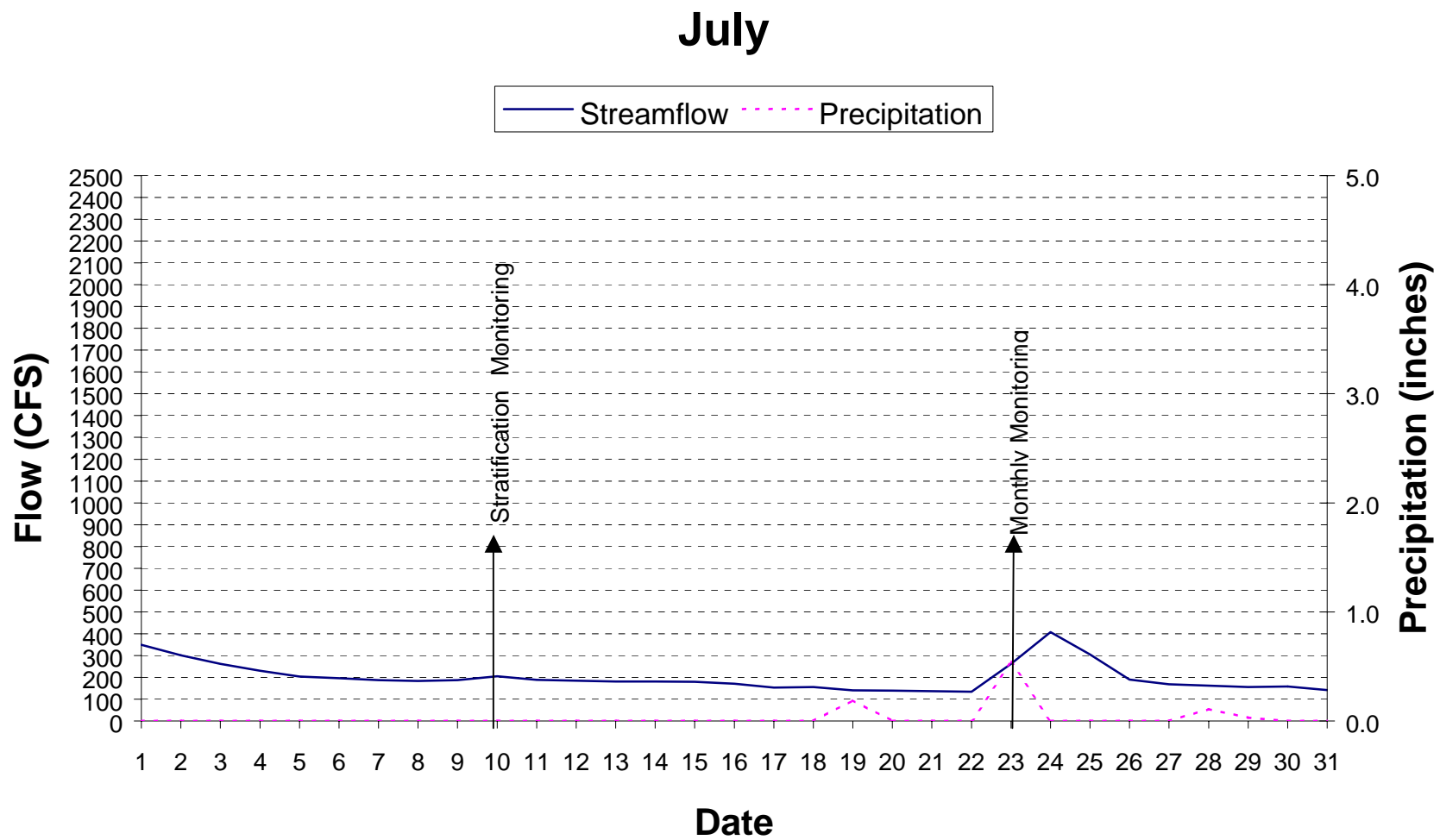


Figure 2-4. July streamflow and precipitation in the vicinity of F.E. Walter Reservoir in 2002

August

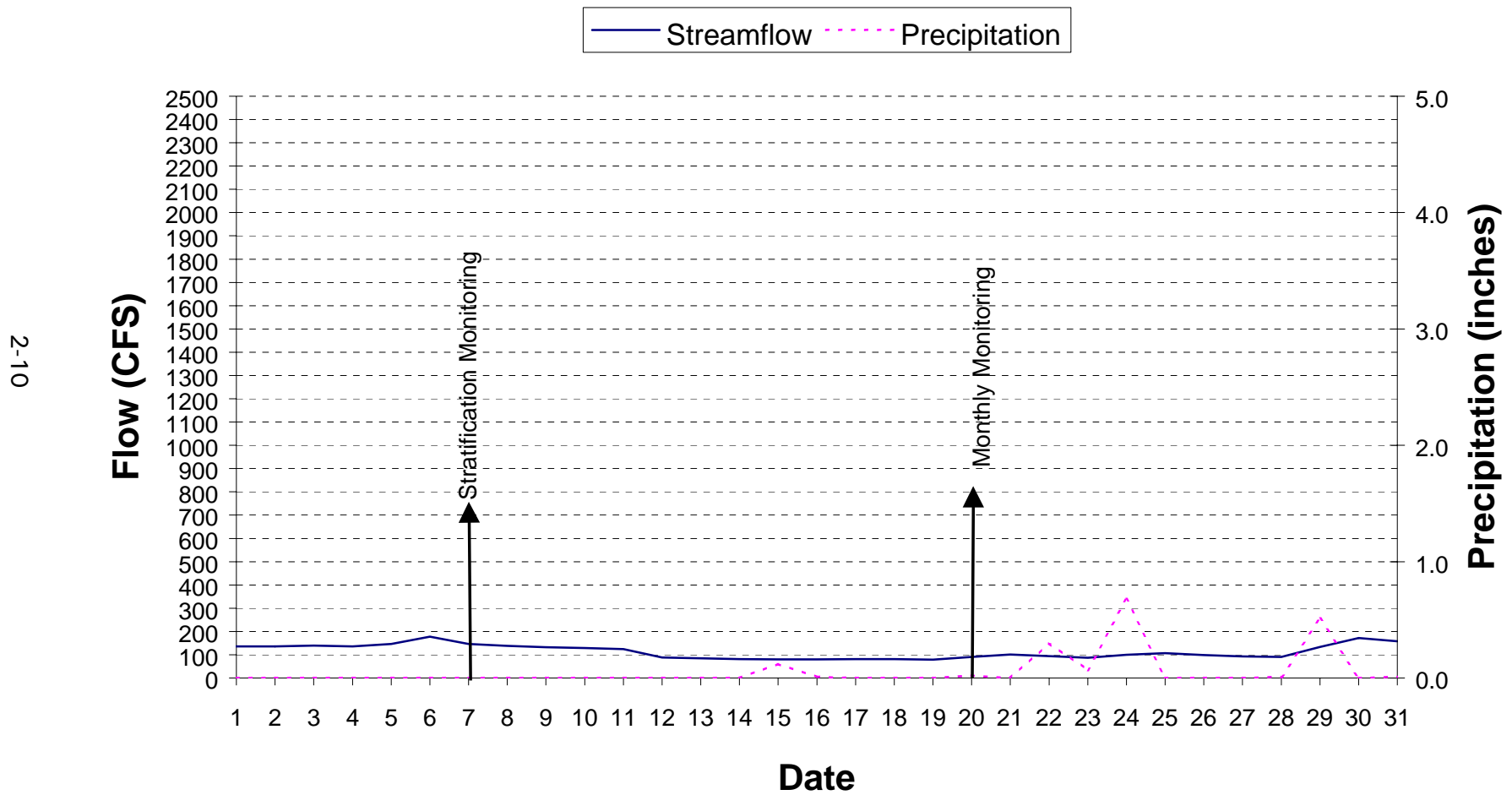


Figure 2-5. August streamflow and precipitation in the vicinity of F.E. Walter Reservoir during August 2002

September

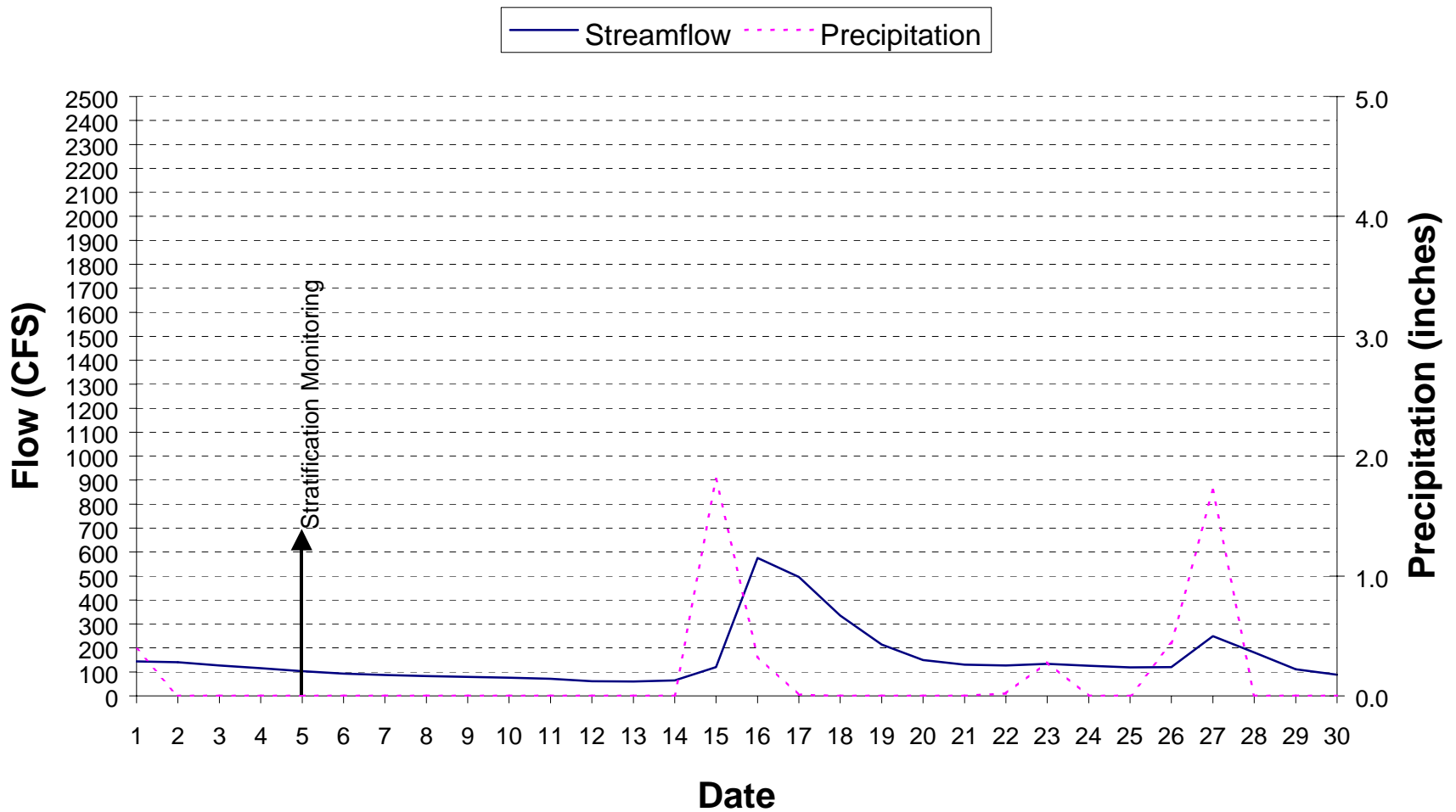


Figure 2-6. September streamflow and precipitation in the vicinity of F.E. Walter Reservoir during September 2002

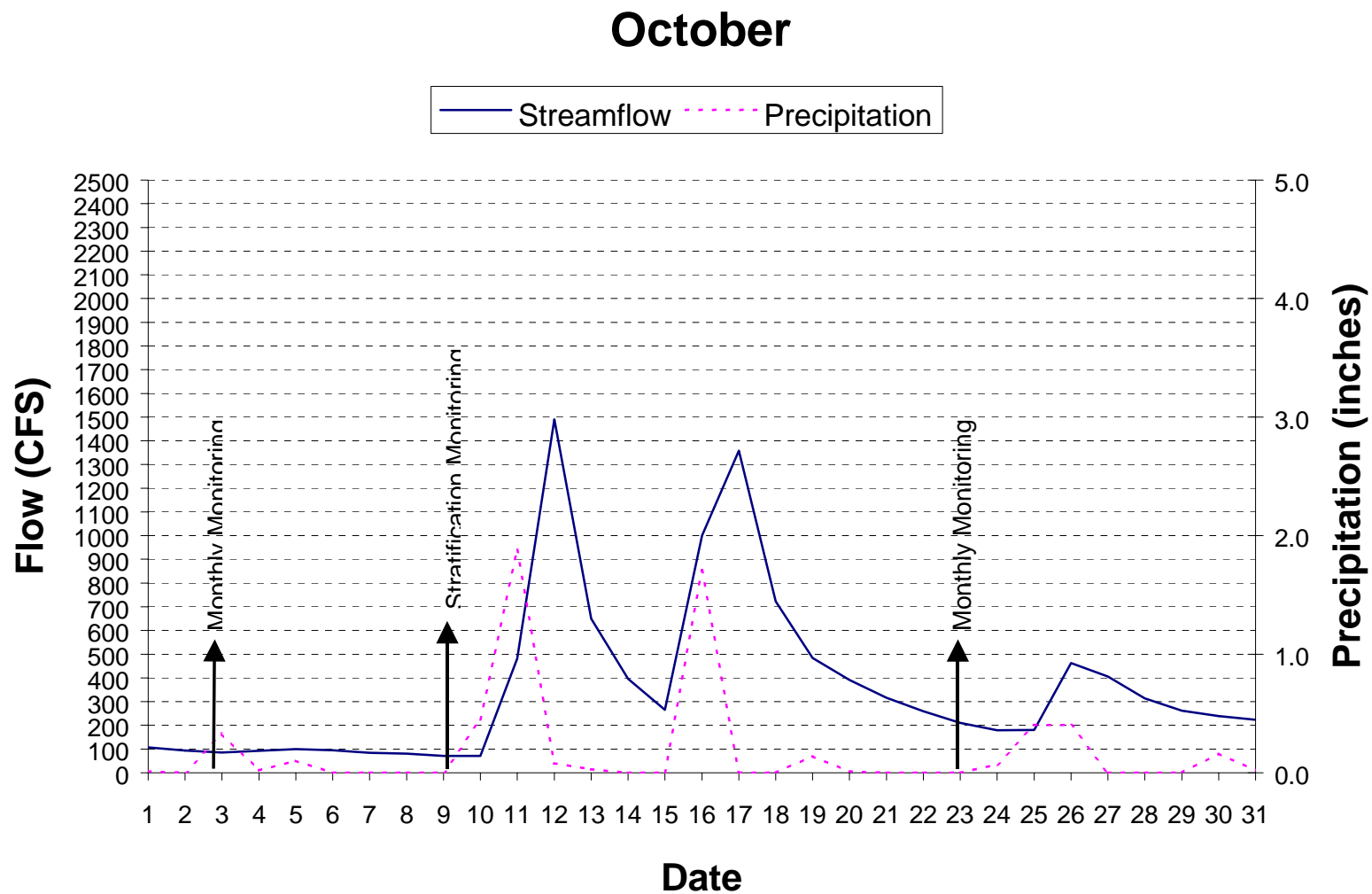


Figure 2-7. October streamflow and precipitation in the vicinity of F.E. Walter Reservoir in 2002

water rinse. Table 2-4 summarizes the parameters monitored, method detection limits, sample hold times, and the laboratory methods used in the analyses.

All sediment contaminant concentrations were reported on a dry weight basis, and were calculated as follows:

$$\text{Dry weight concentration (mg/kg)} = \frac{\text{Wet weight concentration (mg/kg)} \times 100}{\% \text{ solid of sample}}$$

Sample-specific detection limits were calculated for the sediment tests because of matrix interference and the conversion from wet weight to dry weight.

Table 2-4. Sediment priority pollutants, Group 1 – volatile organic compounds, PCB's, and pesticides monitored at F. E. Walter Reservoir during 2002.		
Parameter	Units	Method Detection Limit WA-2
PCBs - Method 8082		
Aroclor-1016	ppb	235
Aroclor-1221	ppb	235
Aroclor-1232	ppb	235
Aroclor-1242	ppb	235
Aroclor-1248	ppb	235
Aroclor-1254	ppb	235
Aroclor-1260	ppb	235
Pesticides - Method 8081A		
4,4'-DDD	ppb	9
4,4'-DDE	ppb	9
4,4'-DDT	ppb	9
alpha-BHC	ppb	9
a-Chlordane	ppb	9
Aldrin	ppb	9
beta-BHC	ppb	9
Chlordane, technical	ppb	94
delta-BHC	ppb	9
Dieldrin	ppb	9
Endosulfan I	ppb	9
Endosulfan II	ppb	9
Endrin	ppb	9
Endrin aldehyde	ppb	9
Endrin ketone	ppb	9
Endosulfan Sulfate	ppb	9
gamma-BHC (Lindane)	ppb	9
g-Chlordane	ppb	9
Heptachlor	ppb	9
Heptachlor epoxide	ppb	9

Table 2-4. (Continued)		
Parameter	Units	Method Detection Limit WA-2
Pesticides - Method 8081A (Continued)		
Methoxychlor	ppb	24
Toxaphene	ppb	9
Volatile Organic Compounds - Method 8260B		
1,1,1,2-Tetrachloroethane	ppb	178
1,1,1-Trichloroethane	ppb	178
1,1,2,2-Tetrachloroethane	ppb	178
1,1,2-Trichloroethane	ppb	178
1,1-Dichloroethane	ppb	178
1,1-Dichloroethene	ppb	178
1,1-Dichloropropene	ppb	178
1,2,3-Trichlorobenzene	ppb	178
1,2,3-Trichloropropane	ppb	178
1,2,4-Trichlorobenzene	ppb	178
1,2,4-Trimethylbenzene	ppb	178
1,2-Dibromo-3-chloropropane	ppb	178
1,2-Dichloroethane	ppb	178
1,2-Dichlorobenzene	ppb	178
1,2-Dichloropropane	ppb	178
1,2-Dibromoethane	ppb	178
1,3,5-Trimethylbenzene	ppb	178
1,3-Dichlorobenzene	ppb	178
1,3-Dichloropropane	ppb	178
1,4-Dichlorobenzene	ppb	178
2,2-Dichloropropane	ppb	178
2-Chlorotoluene	ppb	178
2-Hexanone	ppb	1778
4-Chlorotoluene	ppb	178
Acetone	ppb	1778
Benzene	ppb	178
Bromochloromethane	ppb	178
Bromodichloromethane	ppb	178
Bromobenzene	ppb	178
Bromoform	ppb	178
Bromomethane	ppb	178
c-1,2-Dichloroethene	ppb	178
c-1,3-Dichloropropene	ppb	178
Carbon Tetrachloride	ppb	178
Chlorobenzene	ppb	178
Chloroethane	ppb	178
Chloroform	ppb	178
Chloromethane	ppb	178
Methylene Chloride (DCM)	ppb	178

Table 2-4. (Continued)		
Parameter	Units	Method Detection Limit WA-2
Volatile Organic Compounds - Method 8260B (Continued)		
Dibromochloromethane	ppb	178
Dibromomethane	ppb	178
Dichlorofluoromethane	ppb	178
Ethylbenzene	ppb	178
Hexachloro1,3-butadiene	ppb	178
Isopropylbenzene (cumene)	ppb	178
m,p-Xylene	ppb	178
2-Butanone(MEK)	ppb	1778
4-Methyl-2-pentanone (MIBK)	ppb	1778
Methyl-tert-butylether (MTBE)	ppb	178
n-ButylBenzene	ppb	178
n-Propylbenzene	ppb	178
Naphthalene	ppb	178
o-Xylene	ppb	178
p-Isopropyltoluene	ppb	178
Tetrachloroethene	ppb	178
sec-Butylbenzene	ppb	178
Styrene	ppb	178
t-1,2-Dichloroethene	ppb	178
t-1,3-Dichloropropene	ppb	178
t-Butylalcohol	ppb	1778
Trichloroethene	ppb	178
Toluene	ppb	178
Trichlorofluoromethane	ppb	178
Vinyl chloride	ppb	178

2.7 TREND ANALYSIS METHODS

Annual water quality, sediment contaminant, and drinking water monitoring have been conducted at F.E. Walter Reservoir since 1975. Data collected over these years were compiled in to an electronic database by the USACE (Versar 1996). The compilation of historical data enables the use of statistical trend analysis, an important tool in determining if the water quality at F.E. Walter Reservoir has significantly changed. A number of different trend analysis methods are available; some more complicated than others. For the purpose of this report, we employed two general methods: regression analysis and the Mann-Kendall, or Seasonal Kendall, test.

2.7.1 Regression Analysis

The spatial and temporal distributions of the historical data were examined to determine which parameters had a sufficient time series to warrant meaningful trend analysis. Among the stations monitored for the major water quality parameters (e.g., nutrients, dissolved oxygen, total dissolved solids), downstream station WA-1 and reservoir station WA-2 were consistently sampled over the entire 23-year time series. Water quality trend analyses were limited to the spring (April through June) and summer (July through 15 October) periods. The "spring season" analyses were conceptualized as representing long-term trends associated with inputs to the reservoir during snow melt periods. The "summer season" analyses represented conditions during periods of maximum productivity and most severe low DO stress. Trends at station WA-1 were analyzed separately to evaluate conditions in the Lehigh River downstream of the reservoir. Regression analyses were used to determine if significant change in parameter concentrations occurred over the past two decades. The slope of the regression line was used to estimate the yearly rate of change. For this report, regression analysis was applied to the water quality parameters: total nitrogen, total phosphorus, total dissolved solids, biochemical oxygen demand, and fecal coliform bacteria.

2.7.2 Mann-Kendall Analysis

In addition to regression analysis, the non-parametric Mann-Kendall test was used to determine trends for individual stations over the time span of historical monitoring at F.E. Walter Reservoir. The Mann-Kendall (or Seasonal Kendall) test scores all combinations of yearly change for the tested parameter with a +1 or -1 depending on whether parameter increased or decreased over the time interval. All of the scores are then summed and compared to the chi-square distribution to determine if the parameter has a significant trend (increasing or decreasing) over the time series. For this report, the Mann-Kendall test was applied to the water quality parameters: dissolved oxygen, ammonia, total nitrogen, total phosphorus, total dissolved solids, biochemical oxygen demand, and total and fecal coliform bacteria.

2.8 DRINKING WATER MONITORING

Drinking water was monitored in the operations building of F.E. Walter Reservoir (Table 2-1). Drinking water parameters were divided into Sets A and B. Set A comprised bacteria parameters, total and fecal coliform (for analytical methods, see section 2.4), and nitrate and nitrite. Set A samples were collected 19 June and 20 August. Set B samples were analyzed for primary and secondary contaminants and were monitored 19 June. Table 2-5 summarizes the analytical methods, method detection limits, and sample hold

times for each Set B parameter. All of the drinking water quality parameters were analyzed within their respective maximum allowable hold times during 2002.

Table 2-5. Analytical methods, method detection limits, and sample hold times for drinking water monitored at F.E. Walter Reservoir in 2002				
Parameter	Detection Limits	EPA Method	Allowable Hold Times (Days)	Maximum Hold Time Achieved (Days)
Aluminum	0.003	200.7	183	9
Antimony	0.003	200.7	183	9
Arsenic	0.01	200.7	183	9
Barium	0.005	200.7	183	9
Cadmium	0.001	200.7	183	9
Chromium	0.001	200.7	183	9
Copper	0.001	200.7	183	9
Iron	0.002	200.7	183	9
Lead	0.003	200.7	183	9
Magnesium	0.001	200.7	183	9
Manganese	0.001	200.7	183	9
Mercury	0.0002	245.1	28	5
Nickel	0.001	200.7	183	9
Selenium	0.005	200.7	183	9
Silver	0.001	200.7	183	9
Sodium	0.02	200.7	183	9
Thallium	0.006	200.7	183	9
Zinc	0.003	200.7	183	9
Chloride	0.5	300	28	1
Cyanide, free	0.005	SM 4500CN-I	14	6
Fluoride	0.1	300	28	1
Foaming Agents	0.01	SM 5540C	2	1
Nitrate as N	0.05	300	2	2
Nitrite as N	0.01	300	2	2
PH	+/-0.01	150.1	N/A	0
Sulfate	1	300	28	1
Total Dissolved Solids	10.0	160.1	7	1
N/A – Not applicable				

2.9 HYDROGEN SULFIDE AND DISSOLVED METALS WATER COLUMN TESTING

In December 2001 the Delaware River Basin Commission (DRBC) declared a drought emergency for the Delaware River Basin. In February 2002, the DRBC issued a Resolution authorizing the Executive Director to enter into a contract with the U.S. Army Corps of

Engineers, relating to temporary storage of water at the F.E. Walter Reservoir during emergency drought periods. Due to the drought emergency, the storage of additional water at F.E. Walter Reservoir for the purpose of having that water available to augment low flows in the Delaware River, based on the Trenton Flow Objective, was considered urgent. In response to the drought emergency, the U.S. Army Corps of Engineers began storing water at F.E. Walter reservoir, raising the water level by approximately 70 feet. Personnel located at the F.E. Walter Dam reported the occurrence of a noxious, hydrogen sulfide odor in early August. Ongoing water quality studies indicated that the lake was thermally stratified and anoxic conditions existed throughout the deeper waters of the lake. In an effort to monitor water quality changes associated with the anoxic conditions seen at F. E. Walter Reservoir, the Corps initiated additional water quality sampling.

Hydrogen sulfide and dissolved metals samples were collected on 7 August and 5 September during the monitoring period of 2002 (Table 2-6). Water samples were collected from surface, middle, and bottom depths at stations WA-2, WA-6, and WA-7 (within the reservoir) and two surface stations WA-1 (below the dam) and WA-TB (Tannery Bridge). Table 2-6 summarizes the dissolved metals; laboratory detection limits, state water quality standards, allowable and achieved maximum hold times for each.

Table 2-6. Analytical methods, method detection limits, and sample hold times for dissolved metals and hydrogen sulfide monitored at F.E. Walter Reservoir in 2002				
Parameter	Detection Limits	EPA Method	Allowable Hold Times (Days)	Maximum Hold Time Achieved (Days)
Aluminum	0.003	200.7/6010B	183	5
Antimony	0.003	200.7/6010B	183	5
Arsenic	0.010	200.7/6010B	183	5
Barium	0.005	200.7/6010B	183	5
Cadmium	0.001	200.7/6010B	183	5
Chromium	0.001	200.7/6010B	183	5
Copper	0.001	200.7/6010B	183	5
Hydrogen Sulfide	0.025	376.1	7	4
Iron	0.002	200.7/6010B	183	5
Silver	0.001	200.7/6010B	183	5
Manganese	0.001	200.7/6010B	183	5
Magnesium	0.001	200.7/6010B	183	5
Mercury	0.0002	245.1	183	6
Nickel	0.001	200.7/6010B	183	5
Selenium	0.005	200.7/6010B	183	5
Sodium	0.02	200.7/6010B	183	5
Thallium	0.006	200.7/6010B	183	5
Zinc	0.003	200.7/6010B	183	5

2.10 METEOROLOGICAL MONITORING

Air temperature, relative humidity, solar radiation, wind speed and direction were monitored every ½ hour with a YSI 6200 meteorological station installed and maintained at the Beltzville Reservoir discharge tower. Local weather conditions were recorded with these units from May through October 2002 (Appendix E).

2.11 LEHIGH WATER QUALITY MONITORING

Ambient water temperature was recorded every ½ hour with Onset Computer Corporation TidbiTtm probes at four stations along the Lehigh River. The station locations were WA1 (just below the F. E. Walter dam outfall), mainstem station LH3 (several miles downstream of the dam), LH10 (Lehighton), LH15 (Walnutport), and LH17 (Northampton treatment plant intake).

Water quality monitoring of the Lehigh River was conducted five times during 2002, between July and October (Table 2-1). Monitoring was conducted at five stations WA1, LH3 (Tannery Bridge), LH10 (Lehighton), LH15 (Walnutport), and LH17 (Northampton treatment plant intake) (Fig. 2-1). Physical stratification parameters included temperature, dissolved oxygen (DO), pH, and conductivity. Turbidity and chlorophyll *a* were also monitored at these stations. All of the water quality monitoring was conducted with a calibrated YSI water quality meter.

